NORTH AVENUE BRIDGE
Chicago Bridges Recording Project
Spanning North Branch of the Chicago River at West North Avenue
Chicago
Cook County
Illinois

HAER No. IL-154

HAER
ILL
16-CHIG,
147-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

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HISTORIC AMERICAN ENGINEERING RECORD

HAER
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16-CHIG,
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NORTH AVENUE BRIDGE
~~(NORTH AVENUE BRIDGE)~~
HAER No. IL-154

Location: Spanning North Branch of the Chicago River at North Avenue, Chicago, Cook County, Illinois.
USGS Quad: Chicago Loop
UTM: 16/445535/4639830

Date of Construction: 1907

Designer: Alexander von Babo and Thomas G. Pihlfeldt, Department of Public Works, Chicago, Illinois

Fabricator: American Bridge Company, Toledo, Ohio

Builders: Substructure: Jackson and Corbett Company, Chicago, Illinois; superstructure: Roemheld and Gallery Company, Chicago, Illinois

Present Owner: Chicago Department of Transportation, Chicago, Illinois

Present Use: Highway bridge

Significance: When Chicago became a major commercial and industrial center after the Civil War, the most common American drawbridge was the swing bridge, horizontally rotating on a center pier to open two channels. The center pier, however, became a navigational hazard for the ever-larger craft of the late nineteenth century, especially on crowded, narrow waterways such as the Chicago River. During the late 1890s, Chicago City Engineer John Ericson initiated a planning study to find an alternative to the swing span. Finding inspiration in the 1894 Tower Bridge in London, England, the municipal engineering staff developed a new movable-bridge design. The type was known as a bascule, French for "seesaw." The movable span, or leaf, rotated vertically on a fixed, steel horizontal axle, or trunnion, leaving the entire river channel open for shipping. With the front of the leaf counterbalanced by weights at the rear, relatively small motors could open and close the bridge. The city built its first fixed-trunnion bascule in 1902. The North Avenue Bridge, completed in 1907, was the seventh of the new type to go into operation.

Historian: Jeffrey A. Hess, August 1999.

Project Description: The Chicago Bridges Recording Project was sponsored during the summer of 1999 by HABS/HAER under the general direction of E. Blaine Cliver, Chief; the City of Chicago, Richard M. Daley, Mayor; the Chicago Department of Transportation, Thomas R. Walker, Commissioner, and S.L. Kaderbek, Chief Engineer, Bureau of Bridges and Transit. The field work, measured drawings, historical reports, and photographs were prepared under the direction of Eric N. DeLony, Chief of HAER.

Description[1]

Located in a commercial-industrial neighborhood about two miles northeast of Chicago's main downtown business district, the North Avenue Bridge carries highway and pedestrian traffic over the North Branch of the Chicago River. Just south of the bridge, the river divides into west and east channels that flow southward around Goose Island. The main channel, on the west, more or less follows the river's original winding path. In contrast, the east channel is a completely engineered hydraulic structure on a straight alignment. Known as the North Branch Canal, this mile-long waterway was completed in the mid-1850s to expand dockage space and to serve as a navigable bypass for the river's natural meander. During the late nineteenth century, traffic on the river and the canal created a good deal of congestion at the north end of Goose Island, a constricted spot in the waterway that was rendered all the more difficult for navigation by the center-pier swing span of the 1877 North Avenue Bridge. To provide more maneuvering room for vessels, the federal government in 1906 constructed a "turning basin" below the bridge by removing the island's northwest tip, as well as part of the opposing shore on the river's west bank. A year later, the City of Chicago replaced the obstructive North Avenue Bridge with a new movable span designed to accommodate larger craft.[2]

The new North Avenue crossing was a movable bridge of the double-leaf bascule variety.[3] Named for the French word for "seesaw," a bascule provided a clear channel for

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[1] Unless otherwise noted, this description of site and structure is based on field inspections conducted by the author in July and August 1999.

[2] On the creation of the canal, see Perry R. Duis and Glen E. Holt, "Chicago's Only Island," *Chicago History* (February 1979):170. For the turning basin, see "Report of the Chief of Engineers," *Annual Reports of the War Department for the Fiscal Year Ended June 30, 1903*, vol. 11, pt. 3 (Washington, D.C.: Government Printing Office, 1903), 1892-1896; *Annual Report of the Chief of Engineers, United States Army for the Fiscal Year Ended June 30,* 1906, pt. 2 (Washington, D.C.: Government Printing Office, 1906), 1774. The dates of all Chicago highway bridges constructed before 1950 can be found in City of Chicago, Department of Public Works, Bureau of Engineering, Division of Bridges, "Bridge History and Data," Drawing Nos. 16188-16192, 1943, rev. 1950, in Chicago Department of Transportation, Plan File Archives, 30 North LaSalle Street, Chicago, Illinois (hereafter cited as CDT Plan Archives).

[3] City of Chicago, Bureau of Engineering, Plans for North Avenue Bridge over the North Branch Chicago River, 1904, Drawing Nos. 6690-6710; American Bridge Company, Shop Drawings for North Avenue Bridge, 1906, Drawing Nos. 6230-6337, in CTD Plan Archives. For brief descriptions of the original construction, see Clarence S. Rowe, "New Bridge Construction," *Mayor's Annual Message and the Thirty-First Annual Report of the Department of Public Works . . . Fiscal Year Ending December 31, 1906* (Chicago: W.J. Hartman Co., n.d.), 284; Rowe, "New Bridge Construction," *Mayor's Annual Message and the Thirty-Second Annual Report of the Department of Public Works. .. Fiscal Year Ending December 31, 1907* (Chicago: Cameron, Amberg and Co,. n.d.), 285; Donald N. Becker, "Development of the Chicago Type Bascule Bridge," *American Society of Civil Engineers Transactions* (February 1943):276, 279. Photographs of the newly completed North Avenue Bridge are in *Thirty-Second Annual Report, 1907*, 5, 283 (hereafter the yearly statements of the Department of Public Works will be cited as *DPW Annual Report*, with appropriate year and page).

waterway traffic by vertically rotating a span, or leaf, around a horizontal axis. In the engineering literature, the North Avenue Bridge represented a distinct design known as a "Chicago Type Bascule," so called because it was originally developed, and then widely employed, by Chicago municipal engineers for the city's numerous highway crossings of the Chicago River.[4] As exemplified by the North Avenue Bridge, a Chicago Type Bascule exhibited the following basic characteristics: two counterbalanced, truss-supported leaves rotating on fixed, horizontal, steel trunnions, or axles; counterweights rigidly attached to the rear of the trusses beneath the bridge's deck, or roadway level; and electric-powered operating machinery that opened and closed the leaves by means of a pinion-activated rack incorporated into the rear of each truss.

Measuring about 260 feet in length from abutment to abutment, the North Avenue Bridge consisted of two symmetrical halves, each containing a fixed, steel-girder approach section and a movable leaf supported by three riveted, 115-foot-long, steel trusses spaced on 21-foot centers. The seven-panel trusses were modified versions of a Pratt truss, the most common form of highway bridge built in the United States during the early twentieth century. The North Avenue trusses differed from the standard highway Pratt in the configuration of their tail ends. Instead of displaying inclined end posts at the shore portals, the tail ends of the trusses arced upward from the roadway in a bold curve. To supply rigidity to these tall rear members, the trusses' portals incorporated deep overhead lateral bracing. The remaining forward panels gradually decreased in depth, so that additional overhead bracing was unnecessary. The North Avenue Bridge, therefore, resembled an overhead truss near the shore and a pony truss over the waterway.

The fixed approach section at each end of the bridge was 60 feet in width and carried a roadway of wood paving blocks resting on a concrete slab supported by steel buckle plates between steel floor beams. The approach sidewalks were concrete, with steel mesh railings overlooking the river. The overall width of each movable leaf was also 60 feet, although the wood deck within its trusses was only 42-feet wide. The balance was made up by two nine-foot-wide metal brackets cantilevered from the bottom chords of the outside trusses. The brackets carried eight-foot-wide plank sidewalks, each flanking an 18-foot-wide roadway separated by the center truss. Each roadway carried streetcar tracks.

The substructure of each leaf was divided into two basic components: a solid abutment set back from the shore and a hollow pier extending into the waterway. Both were stone-capped reinforced-concrete structures resting on wood piling. The leaf's superstructure was counterbalanced by a concrete and cast-iron counterweight enclosed in a riveted, steel-plate box rigidly attached to the three trusses at the tail end of their bottom chords. The counterweight arrangement placed the movable leaf's center of gravity near the center of the arc formed by the trusses' curved rear members. At the center of gravity, the bottom chords of each truss were rigidly connected to a transverse, 16-inch-diameter, cast-steel trunnion, designed to serve as a rotating axle for lifting and lowering the movable leaf. As measured over the waterway, from

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[4] See, for example, C.B. McCullough and Phil A. Franklin, "Bascule Bridges," *Movable and Long-Span Steel Bridges*, ed. George A. Hool and W.S. Kinne (New York: McGraw-Hill Book Company, 1923), vol. I, 20.

leaf to leaf, the trunnions stood 173 feet apart. Bearings enclosed each end of the trunnions, and these fixtures rested on 33-foot-long, inverted, triangular, riveted, steel trusses that spanned the hollow portion of the pier. The trunnion trusses also carried built-up steel columns supporting, by means of transverse built-up I-beams, the front part of the bridge's fixed approach section. The approach section joined the movable-leaf roadway on the water side of the trunnions. The location of this joint was one of the bridge's significant design features. It ensured that highway traffic entered the movable leaf in front of the center of the gravity, so that there was no danger of the live load opening the leaf.

Since the movable leaves were counterbalanced, relatively little power was required to open and close the bridge. For each leaf, the motive force took the form of two 40-horsepower, direct-current motors mounted, along with the rest of the lifting machinery, on a steel framework fixed to a concrete slab beneath the approach roadway, between the abutment and pier.[5] The motors turned two parallel horizontal shafts connected by a train of equalizing gears so as to operate as a unit. Operating through enclosed, oil-bathed worm gears and open bevel gears, the two shafts powered a single horizontal shaft that relied on open gearing to turn the final drive shaft. This last shaft carried three open pinions, each designed to engage an open cast-steel rack bolted to the curved tail end of one of the movable-leaf trusses.[6]

To raise the leaf, the drive chain powered the racks downward causing the trusses to rotate on their trunnions, thereby lifting the front of the leaf away from the waterway. As the tail ends of the trusses descended, they carried the counterweight downward into the hollow section of the pier. In fully open position, the bridge provided a clear channel of 137 feet. Closing the leaf was simply a matter of reversing the motors. Manually operated band brakes connected to the drive train arrested the leaf's movement at each end of travel, bringing the tail ends of the three movable-leaf trusses to rest against bumper blocks attached to substructure steelwork.[7] In addition, the bridge was equipped with electric-powered, bolt-type center locks, which tied together the truss ends of the two movable leafs in order to ensure rigidity of the bascule span

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[5] The machinery area between the abutment and pier is currently enclosed by siding. Although the design drawings are silent on the matter, the original construction, in the interest of public safety, probably contained a similar feature.

[6] The machinery layout copied the drive train of the North Western Avenue Bridge, a city-designed structure completed over the North Branch of the Chicago River in 1904. By inserting worm gears into the power-transmission chain, the city engineers hoped to prevent "any movement of the bridge due to wind, as pressure applied to the leaf and transmitted to the worm wheel cannot turn the worm, which thus holds the bridge positively in position." See "Trunnion Bascule Bridge at Northwestern [sic] Ave., Chicago," *Engineering News* 53 (19 January 1905):64.

[7] The lower bumper blocks, made of wood, hung from the bottom rear of the trunnion-support trusses. At the end of the closing cycle, the tail end of the counterweight box pushed upward against these blocks, cushioning the contact of the leaf against the substructure. The upper bumper blocks were fashioned of rubber. Located slightly above and behind the lower bumpers, they were mounted on a bracket extending from the steelwork supporting the fixed approach section. At the end of the opening cycle, the upper bumpers absorbed the impact of metal bumpers riding on the curved tail ends of the bascules trusses.

under live load. The center locks, brakes, and motors were all controlled from a wood-framed, gable-roofed operator's house standing adjacent to the fixed approach section on a steel cantilevered frame directly supported by the substructure. The west-leaf house stood on the south side of the bridge; the east-leaf house on the north side.

Neither of the original operator's houses survives. At least one was replaced as early as 1915.[8] The two houses currently on site may be of that vintage, but they have been remodeled so anonymously that it is difficult to discern their age. Both are wood-framed, plywood-sided, hipped-roofed structures with boarded windows. The bridge experienced its first major overhaul in the 1920s, when its centerlock and brakes were rehabilitated and its deck system replaced. Additional renovations occurred in the early 1960s and mid 1970s, both involving redecking and the replacing of structural steel in the movable-leaf trusses.[9] The first effort initiated the use of open-grid steel roadway on the movable leaves. The second installed the bridge's present railing system, a metal balustrade of utilitarian design. Although the North Avenue Bridge still resembles its original design, it no longer functions as a movable span. The electric motors have been removed from the drive trains, the operator's houses have been cleared of their control equipment, and the front ends of the movable leaves have been bolted shut.

History

Between 1865 and 1890, the City of Chicago built 55 movable highway bridges over waterways within municipal limits. All were center-pier swing spans, the most popular type of movable bridge in the United States at the time.[10] Despite its ubiquity, the swing span was not universally admired. Its critics pointed to the fact that the center-pier design was becoming a navigational hazard for the ever-larger vessels of the late nineteenth century. They also noted that the swing span's requirement of a clear turning radius often prohibited the development of docking facilities adjacent to the bridge site. These shortcomings were especially onerous along highly industrialized urban waterways such as the Chicago River, where shipping channels

[8] City of Chicago, Department of Public works, Bureau of Engineering, Division of Bridges, "Proposed Repairs and Betterments for 1920 and Principal Repairs and Betterments Completed 1913-1919," 1919, Drawing No. 7152, in C DT Plan Archives.

[9] See the following drawings in the CDT Plan Archives: Drawing Nos. 10561-10578, 1926; Drawing Nos. 11688-11691, 1927; Drawing Nos. 23401-23418, 1960; Drawing Nos. 18826-28845, 1960; Drawing Nos. 28379-28385, 1974.

[10] The statistic does not include projects that relocated an old span to a new site. One bridge was built over the Calumet River; the remainder, over the various branches of the Chicago River. See City of Chicago, Department of Public Works, Bureau of Engineering, Division of Bridges, "Bridge History and Data," 1943, rev. 1950, Drawing Nos. 16188-16192, in CDT Plan Archives.

tended to be narrow, highway crossings numerous, and real estate prices high.[11]

No matter how vociferously shipping and real estate interests might decry the center-pier swing span, there was no effective means of regulating movable-bridge design until the early 1890s, when Congress authorized the War Department to approve plans for all new bridges over navigable waterways and to seek the alteration of any existing bridge that interfered with navigation.[12] In 1892, the U.S. Army Corps of Engineers demonstrated both provisions of the law on the South Branch of the Chicago River, by ordering the removal of a recently completed swing span at Canal Street and by prohibiting the construction of a new swing span at South Halsted Street. As Chicago's Commissioner of Public Works observed in his annual report for 1892, "This Department found it necessary to look about and devise some plan that would meet these objections."[13] The result was a decade-long search by Chicago city engineers for a reliable, cost-effective, movable bridge that did not obstruct the shipping channel.

During the next three years, the city built three different types of movable bridges over the South Branch of the Chicago River: a double-leaf, folding-lift bridge at Canal Street (1893); a vertical-lift bridge at South Halsted Street (1894); and a double-leaf, rolling-lift bridge at West Van Buren Street (1895). Each embodied a newly patented design that operated on a different principle. The folding-lift bridge employed a counterweighted, segmented leaf, hinged at the rear and at the middle. When the operating machinery was set in motion, the leaf folded up like a jackknife, the rear segment pivoting upward and the front segment dropping downward. The vertical-lift bridge mimicked the action of a double hung-window, using tower-supported pulleys and cables to lift and lower a counterweighted horizontal span. The rolling-lift bridge, as its name implied, was subject to two types of movement. At the same time that the leaf rose vertically from the water, it also moved horizontally toward the shore. Resting on tracked, curved supports known as "segmental girders," the leaf rolled backwards and forwards like a rocking chair, thereby raising and lowering its front end. The folding-lift patent was controlled by Shailer and Schniglau, a Chicago contracting firm; the vertical-lift patent, by engineer J.A.L. Waddell of Kansas City, Missouri; and the rolling-lift patent, by the Scherzer Rolling Lift Bridge Company of Chicago.[14]

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[11] Jeffrey A. Hess and Robert M. Frame III, *Historic Highway Bridges in Wisconsin. Volume 3. Movable Bridges*. (Madison, WI: Wisconsin Department of Transportation, 1996), pt. 1, 10.

[12] W.M. Black, "Bridges Over Navigable Waters of the United States," *Engineering News* 29 (13 April 1893):341-342.

[13] *Mayor's Annual Message and Seventeenth Annual Report of the Department of Public Works . . . Fiscal Year Ending Dec. 31st 1892* (n.p., n.d.), 10, 57-58.

[14] Anticipating the federal government's objections to the swing span, the city had begun searching for an alternative design before the Corps of Engineers' official prohibition. In 1890, the Department of Public Works contracted with Shailer and Schniglau to build a folding-lift bridge over the North Branch Canal at Weed Street. Completed in 1891, this structure was plagued by mechanical problems. The 1892 Canal Street Bridge was supposed to be an improved version, but it, too, failed to give satisfaction. Its mechanical system was completely

As might be expected with new inventions, all three bridges experienced mechanical difficulties during their first years of operation, but the rolling-lift design seemed to be the most promising of the lot. Incorporating the fewest movable parts, it appeared to be the simplest to build and the cheapest to maintain. In 1895, the Chicago Department of Public Works contracted for the construction of a second rolling-lift bridge, which was completed over the North Branch of the Chicago River at North Halsted Street in 1897. It soon became apparent, however, that there were structural as well as mechanical problems with the new rolling-lift design. In 1898, City Engineer John E. Ericson observed that the concrete foundations of the new North Halsted Street Bridge needed to be strengthened. A year later, he reported that the bridge's substructure was literally "falling to pieces."[15] The problem was that the rolling-lift design was best suited for sites with easily accessible bedrock to support bridge foundations, a geological condition that did not exist along the Chicago River. As a Chicago municipal staff engineer explained:

> These [rolling-lift] bridges, although marked improvements over the folding and [vertical] lift bridges, have some objections. The main objection lies in the fact that this type of bridge requires a most solid foundation, as the whole load in opening and closing travels horizontally over a space of from twenty to thirty feet on the substructure. The points of application of this load during operation of the bridge change continuously, and,

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rebuilt in 1897. The Weed Street Bridge was so poorly designed that it was permanently closed in 1899. Although the folding-lift patent was controlled by Shailer and Schniglau, the inventor and original patent holder was William Harmon of Chicago. See *DPW Annual Report, 1890*, 160, 162, 165; "A Folding-Floor Drawbridge," *Engineering News* 25 (23 May 1891): 486-487; *DPW Annual Report, 1897*, 124; City Council, Proceedings, 18 September 1899, 1060; William Harmon, U.S. Patent No. 383,880, 5 June 1888. From the very beginning, the Department of Public Works had misgivings about Waddell's vertical-lift bridge. As one municipal engineer commented during the bridge's construction, "The whole work is an expensive experiment." Largely because of the South Halsted Street Bridge's reputation for "heavy first cost and maintenance, and expensive operation," it took Waddell over a decade to secure his next vertical-lift commission. In Chicago itself, a second vertical-lift highway bridge was not constructed until 1938, at Torrence Avenue over the Calumet River. See City Council, Proceedings, 29 May 1893, 334; J.A.L. Waddell, "The Halsted Street Lift-Bridge," *American Society of Civil Engineers Transactions*, Paper No. 742 (1895):1-16; C.C. Schneider, "Movable Bridges," *American Society of Civil Engineers Transactions*, Paper 1071 (1908):268-269; Hess and Frame, 13-15; Waddell, U.S. Patent No. 506,571, 10 October 1893. The rolling-lift bridge at West Van Buren Street was constructed simultaneously with an adjacent Scherzer bridge commissioned by the West Side Metropolitan Elevated Railroad Company. The design was the creation of William Scherzer, a Chicago-based, Swiss-trained engineer who was familiar with French attempts to develop a wheel-mounted bascule earlier in the century. Scherzer filed a patent application for his invention, but died a few months before its approval. The patent became the property of his brother Albert, who organized the Scherzer Rolling Lift Bridge Company to sell rights to the design. See "Van Buren Street Rolling Lift Bridge," *Engineering Record* 31 (16 February, 2 March 1895):204-206, 242-243; "The Van Buren Street Rolling Lift Bridge, Chicago," *Engineering News* 32 (21 February 1895):114-115; Hess and Frame, 21-22; William Scherzer, U.S. Patent No. 511,713, 26 December 1893. For general overviews of the city's movable-bridge projects during the 1890s, see *DPW Annual Report, 1900*, 87-88; Becker, 266-270.

[15] *DPW Annual Report, 1894*, 23-24; *DPW Annual Report, 1895, 50; DPW Annual Report, 1896*, 104, 110; City Council, Proceedings, 12 September, 1898, 587; 18 September 1899, 1060.

> in connection with the wind pressure, have a very severe action on the foundation, which, if not built of extraordinarily large dimensions, and consequently at great expense, or on solid rock, shows a wagging motion, as the Halsted street bridge over the North branch of the river sufficiently proves.[16]

Disenchanted with the patented designs available on the market, City Engineer Ericson in 1898 recommended that "the city take up the question of investigating movable bridges for the purpose of designing their own bridges."[17] At the time, the city's finances were in an extremely embarrassed condition. Because of state-mandated restrictions on municipal taxing and bonding powers, the city lacked funds to pay for even basic bridge maintenance, let alone elaborate new design studies.[18] Ericson, therefore, decided on a simple paper investigation by in-house staff. His goal was "a critical analysis of the literature on movable bridges built in the United States and Europe, with the view of selecting a type of bridge suitable to the requirements of the Chicago river and its branches." By 1899, Ericson and his colleagues had decided that the most appropriate model for Chicago was the Tower Bridge of London, England. Completed in 1894, this structure was a counterweighted, double-leaf, fixed-trunnion bascule with below-deck operating machinery.[19]

The counterbalanced-lever principal of the Tower Bridge was appealing for three main reasons. First, it relied on relatively simple operating machinery that was fairly easy to manufacture and install. Second, it was patent-free, so that its use entailed no royalty payments. Third, it dictated a bridge with a fixed center of gravity, so that the action of the movable leaves would not alter the distribution of stresses on the bridge's substructure. With his technological quest at an end, Ericson supervised the preparation of "three complete designs . . . differing in appearance, method of mounting, etc., but all involving the main feature, that of revolving on a fixed trunnion."[20] These designs were then submitted to an outside panel of mechanical and civil engineers, who approved the basic fixed-trunnion concept but suggested certain improvements regarding the substructure, flooring system, and operating equipment. Beginning with the appropriation ordinance of 1900, the City Council cobbled together sufficient funds to allow Ericson to replace five severely deteriorated swing spans with new fixed-trunnion, double-

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[16] *DPW Annual Report, 1900*, 88.

[17] "Testimony of John Ericson," *The Scherzer Rolling Lift Bridge Company vs. City of Chicago and Great Lakes Dock Company*, 6, U..S. Court of Appeals, Seventh Circuit, Records and Briefs, October 1924, Case No. 3606, in Record Group 276, National Archives, Chicago.

[18] *DPW Annual Report, 1899*, 68; *DPW Annual Report, 1901*, 5-10.

[19] "Testimony of Thomas G. Pihlfeldt," *Scherzer vs. Chicago*, 93. Pihlfeldt identified the Tower Bridge as the model in Dan Fogle, "Modest Man is Pihlfeldt," *Chicago Daily New*, 15 October 1936, 21. For a description of the Tower Bridge, see Ottis Ellis Hovey, *Movable Bridges* (New York: John Wiley and Sons, 1926), vol 1, 83-88.

[20] *DPW Annual Report, 1900*, 88.

leaf bascules based on in-house designs. The new structures were completed at Clybourn Place (later renamed Cortland Street) over the North Branch of the Chicago River (1902); at Division Street over the North Branch Canal (1903); at Ninety-Fifth Street over the Calumet River (1903); at Division Street over the North Branch (1904); and at North Western Avenue over the North Branch (1904).[21]

Although Ericson had rejected the Scherzer rolling-lift design, the Department of Public Works was not the only builder of movable highway bridges in Chicago. In 1889, the state legislature had chartered an independent government agency, the Sanitary District of Chicago, and had given it wide powers over the Chicago River.[22] The Sanitary District's primary responsibility was to reduce the pollution of the waterway, which had long been used for disposing sewage and refuse. As dictated by the region's natural hydraulic patterns, the Chicago River system sluggishly drained into Lake Michigan, just north of the downtown commercial neighborhood. The Sanitary District intended to alter this state of affairs by constructing a canal to drain the waterway away from the city, southward into the Desplaines River, a tributary of the Illinois River, which, in turn, emptied into the Mississippi River. The Chicago River would become an outlet of Lake Michigan, which, instead of receiving the city's pollution, would help flush it, in somewhat diluted form, into the Mississippi.[23] To accommodate the Chicago Rivers's increased flow, the Sanitary District also intended to widen the waterway at several points, which required the replacement of several municipal highway bridges. In 1898, while the drainage canal was still under construction, the Sanitary District embarked on the reconstruction of the Taylor Street Bridge over the South Branch of the Chicago River, with the understanding that the city would maintain and operate the structure after its completion. Following the example set by the Department of Public Works in the construction of the West Van Buren and North Halsted street bridges, the Sanitary District selected the Scherzer rolling-lift design for its project.[24] A year later, in 1899, the agency decided that its engineering program also required the replacement of the ill-fated Harmon bascule at Canal Street. By this time, however, Ericson had deep misgivings about the way the Scherzer Company designed its bridges, and he secured the Sanitary District's consent to consult on design selection. Since the Scherzer rolling-lift bridge

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[21] City Council, Proceedings, 4 April 1900, 2817; *DPW Annual Report, 1901*, 5-10; *DPW Annual Report, 1904*, 16-17.

[22] "History of the Sanitary District of Chicago and the Drainage Problem, with the Law Relating to the Same," in *DPW Annual Report, 1889*, 67-93.

[23] On the construction of the new canal and related features, see Mary Yeater Rathbun, *Architectural and Engineering Resources of the Illinois Waterway between 130th Street in Chicago and La Grange, Illinois* (Carbondale, IL: American Resources Group, Ltd for U.S. Army Corps of Engineers, Rock Island District, Rock Island, IL, 1996), 46-60.

[24] Board of Trustees of the Sanitary District of Chicago, *Proceedings, 1898*, 23 November 1898, 5275-5276; *Proceedings, 1900*, 3 December 1900, 6882. Henceforth, these board minutes will be cited as *SDC* Proceedings, with appropriate date and page.

still seemed to be the most efficient and economical alternative to the center-pier swing span, the Scherzer company secured the Canal Street contract as well, but Ericson attempted to force the company to strengthen its foundation design. The outcome apparently was to no one's satisfaction. The Sanitary District and the Scherzer Company resented Ericson's meddling, and Ericson developed a firm dislike for the Scherzer Company's business practices.[25]

If Chicago municipal finances had been in a healthier condition at the turn of the century, Ericson might have had greater leverage with the Scherzer Company. But the city could not afford to take over the construction of the Sanitary District's highway bridges. Indeed, the city could not afford even to replace some of its own most hazardous crossings. In the spring of 1900, Chicago Mayor Harrison H. Carter appealed to the better-funded Sanitary District to assist the city in replacing its deteriorating and obstructive swing spans. As the mayor pointed out, the Sanitary District was responsible for maintaining the flowage rate of the Chicago River at certain legislatively set limits in order to keep the waterway free from sewage build-up. Since the center-pier swing spans impeded the river's flow, the Sanitary District, so the mayor reasoned, had an obligation to replace the structures. Although this argument may not have stood up in a court of law, the Sanitary District had its own legal reasons for acceding to the mayor's wishes. A few months earlier, the district's drainage canal had gone into service, with an unexpected consequence. Not only did the canal reverse and increase the flow of the Chicago River, but it also made navigation on the waterway more difficult, especially in the vicinity of center-pier bridges. Fearful that it might be held liable for shipping accidents associated with the more swiftly flowing waterway, the Sanitary District agreed to begin the replacement of certain center-pier bridges. For its part, the city agreed to eventually repay a portion of the construction costs and to assume responsibility for maintaining and operating the new spans. Unlike the Canal Street Bridge project, however, the Department of Public Works was to have no say in the bridge-selection process. Instead, the Sanitary District was to be completely in charge of design and construction, subject only to the federally mandated review of bridge plans by the Corps of

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[25] *SDC Proceedings*, 30 August 1899, 6016; 21 February 1900, 6307-6308; 24 October 1900; 3 December 1900, 6882. Ericson and the Sanitary District initially considered using another rolling-lift design invented and patented by Milwaukee engineer Max G. Schinke. In the Schinke bascule, a counterbalanced leaf was supported by a pivoted swinging arm at the front end while attached to rollers set in a curved stationary track at the rear end. The bridge was set in motion by a simple strut connected to a power source. When the strut pulled back on the span, the front end of the leaf arced upwards, while the rear end rolled downwards along the curved track. Because of the track's shape, the leaf's center of gravity retreated and advanced in a horizontal line, thereby maintaining a counterbalanced system. Between 1895 and 1897, the City of Milwaukee built two Schinke bascules. Although the bridges appear to have functioned fairly well, their curved tracks were expensive to fabricate and difficult to install. In 1900, Milwaukee adopted fixed-trunnion bascule bridges that were similar in several respects to the bascule design developed by Ericson. No Schinke bascules were ever built in Chicago. See Hess and Frame, 26-29, 36-50; Max G. Schinke, U.S. Patent No. 517,808, 3 April 1894; No. 551,004, 10 December 1895; "Sixteenth Street Bascule Bridge, Milwaukee," *Engineering Record* 31 (9 March 1895):256-257; M.G. Schinke, "The New Huron Street Lift Bridge, Milwaukee, Wis.," *Engineering News* 37 (22 April 1897):253-255.

Engineers.[26] Under this arrangement, the Sanitary District built a total of eight movable highway bridges. Seven were Scherzer rolling lifts.[27] The eighth was based on an untried bascule design that had been developed by John W. Page, formerly a staff engineer with the Sanitary District.[28]

In 1904, the City Council of Chicago finally gained the legal authority to increase the level of municipal indebtedness and to float a bond issue for public improvements. The Department of Public Works immediately began planning for the construction of several movable bridges.[29] The design of these projects was to be the responsibility of Thomas G. Pihlfeldt, a Norwegian-born, German-trained engineer who, after entering the municipal bridge division in 1894, had become "Structural Iron Designer in Charge" in 1901. Pihlfeldt's "Assistant Designer" was Alexander von Babo. Like Pihlfeldt himself, von Babo had helped

[26] *SDC Proceedings,* 11 April, 16 May 1900, 6410-6411, 6556 ; City Council, Proceedings, 16 July 1900, 6718-6719. For the Sanitary District's concern over its potential legal liabilities, see *SDC Proceedings,* 21 March, 4, 11 April, 11 July, 1900, 6355-6356, 6386-6387, 6394-6395, 6411, 6642-6643.

[27] The Scherzer bridges were built over the main river at State Street (1903) and Dearborn Street (1905); and over the south branch at Throop Street (1903), Loomis Street (1904), Harrison Street (1905), Eighteenth Street (1905), and Cermak Road (1906).

[28] *SDC Proceedings,* 20 June 1900, 6648-6649; "The [South] Ashland Avenue Bascule Bridge, Chicago," *Engineering Record* 43 (27 April 1901):3392-394; "Page Bascule over the [West Fork of the South Branch of] the Chicago River at [South] Ashland Ave.," *Engineering News* 45 (25 April 1901):311-312. Like the bascule developed by the city's engineering staff, the original Page design for South Ashland Avenue was a counterweighted, double-leaf structure pivoting on fixed trunnions in the lower chords of the bascule trusses. The two designs, however, had completely different detailing and operating principles. In the Page bascule, there were two types of counterweights: (1) overhead cast-iron blocks rigidly suspended from the top chord of the bascule trusses, and (2) movable steel struts pivoted at one end to the fixed approach section and at the other end to heavy, steel, transverse girders supported by rollers resting on the tops chords of the bascule trusses. The transverse girders carried an electric-powered drive chain containing pinions that meshed with curved racks mounted on the top chords of the bascule trusses. During the bridge's opening cycle, the pinion-and-rack arrangement caused the transverse girders to roll slightly forward and the bascule trusses to pivot open on their trunnions. The curvature of the racks was calculated to compensate for the movement of the transverse girders, so that the bridge's center of gravity at all times remained at the fixed trunnions. Shortly after the Sanitary District accepted this bascule design, Page developed a simplified deck-truss version that completely eliminated the rolling segment of the counterweight. In this version, as completed at South Ashland Avenue in 1902, the bridge's approach spans functioned as counterweights pivoting in the abutments. The river ends of the spans rested on rollers that engaged curved tracks in the tail ends of the bascule deck trusses. As in the original design, the tracks' curvature maintained the center of gravity at the trunnions. See "The [South] Ashland Avenue Bascule Bridge, Chicago," *Engineering Record* 48 (10 October 1903):434-436. Although the South Ashland Avenue Bridge appears to have given satisfactory service until its replacement in 1936, neither the Sanitary District nor the city built another Page bascule.

[29] *DPW Annual Report, 1904,* 16-17.

Ericson develop the city's fixed-trunnion bascule design.[30] By December 1904, Pihlfeldt and von Babo had prepared a set of plans for the first of the bond-funded bridges, which would serve as a replacement for the severely deteriorated, center-pier, swing span built in 1877 over the North Branch of the Chicago River at North Avenue. The bridge's fixed-trunnion, double-leaf, bascule superstructure closely copied the engineering of the 1904 West Division Street Bridge, while its substructure and operating machinery followed the layout of the 1904 North Western Avenue Bridge.[31]

Although the city engineers seem to have had every intention of using their own design, the Commissioner of Public Works, F.W. Blocki, motivated apparently by legal reasons, informed the Scherzer Company that "the City of Chicago has no objection to advertising for proposals for the building of a bascule bridge of the Scherzer type at North [A]venue; provided plans for such proposals are made to conform in every respect with all the requirements of the city's specifications for such a bridge."[32] In February 1905, Ericson sent the Scherzer Company the North Avenue Bridge specifications, which contained provisions concerning substructure and counterweight design that would have required the company to alter its standard treatment of these features. John W. Page, the inventor of the bascule type built by the Sanitary District at South Ashland Avenue in 1902, also received the city's specifications, and he duly submitted a design. In March 1905, the city ruled that Page's design was not in compliance and therefore should not be considered by potential bidders on the North Avenue Bridge project.[33] The Scherzer Company took a different tack. Instead of presenting a preliminary design for city approval, it waited until the bidding deadline and then submitted two proposals, both of which ignored the objectionable provisions in the city's specifications. One proposal, in the amount of

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[30] *DPW Annual Report, 1901*, 101; "The Chicago Type Bascule Bridge," *Engineering Record* 42 (21 July 1900):50. There is little biographical information available on von Babo. He remained a bridge engineer with the city until 1915. On Pihlfeldt, see "Pihlfeldt Dies at 82; Designed 50 Bridges for City in 51 Years," *Chicago Daily News*, 23 January 1941, 14; Kenneth Bjork, *Saga in Steel and Concrete* (Northfield, MN: Norwegian-American Historical Association, 1947), 121-126.

[31] City of Chicago, Bureau of Engineering, Plans for North Avenue Bridge over the North Branch Chicago River, 1904, Drawing Nos. 6690-6710, in CDT Plan Archives. In 1899, Ericson had described the North Avenue Bridge as " likely to be closed any time" in view of the fact that "the wooden member is rapidly rotting away, iron work badly rusted and center pier shaky and rotten"; see City Council, Proceedings, 18 September 1899, 1060. On the West Division Street Bridge and North Western Avenue Bridge, see "The Division Street Bascule Bridge, Chicago," *Engineering Record* 42 (20 August 1904):215-217; "Trunnion Bascule Bridge at Northwestern [sic] Ave., Chicago," 64-65.

[32] F.W. Blocki to Frank Montgomery and Co., 22 December 1904, in "Bill for Injunction, Exhibit A, filed 31 March 1905, *Albert H. Scherzer v. City of Chicago et. al*, Case File No. 243514, Superior Court, Cook County, Illinois, in Clerk of the Circuit Court of Cook County, Illinois, Archives, Daley Center, Chicago, IL. Frank M. Montgomery and Company served as Scherzer's engineering and construction company in Chicago.

[33] The Scherzer Company was notified of Page's disqualification in a letter from Ericson dated 18 March 1905; see"Bill for Injunction," Exhibit B, *Scherzer v. City of Chicago.*

$160,000, offered "an artistic deck Scherzer Rolling Lift Bridge with arched outline (similar to the Scherzer. . . Bridge [built for the Sanitary District in 1905] across the Chicago River at State Street)." The other, in the amount of $150,000, was for "a through Scherzer rolling lift bridge (similar in outline to the 'Ericson Trunnion Bridge' of which plans prepared by the city are on file)."[34] When the Department of Public Works opened the North Avenue Bridge bids on 31 March 1905, it rejected both Scherzer proposals for non-compliance. Contracts totaling $193,352 were then awarded to low-bidding firms that had adopted the city's fixed-trunnion bascule design, $81,369 going to Jackson and Corbett Company for substructure work, and $111,983 to Roemheld and Gallery Company for superstructure work.[35] The Scherzer Company, filing on behalf of itself and the taxpayers of Chicago, immediately obtained an injunction from the Superior Court of Cook County to stop the letting of the contracts, on the grounds that the Department of Public Works had "maliciously, fraudulently, and unlawfully" prohibited the company from providing Chicago with "a superior type of bridge . . . at a great saving in cost."[36]

Additional legal judgments proved unnecessary in the dispute over the North Avenue Bridge. In August 1905, Scherzer and the city resolved their differences to the extent that the court dissolved its injunction prohibiting the letting of the contracts. The exact terms of the settlement were never published, and the two sides later gave conflicting accounts of the matter, the Scherzer Company asserting that the Department of Public Works had promised to revise its

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[34] Frank M. Montgomery and Co. to F.W. Blocki, 31 March 1905, in "Supplemental Bill," Exhibit C, filed 11 April 1905, *Scherzer v. City of Chicago*. The Scherzer Company appears to have hoped that its "artistic" bascule design would rally public support in its favor. In 1900, the newly established Municipal Art League of Chicago, which counted among its members such influential architects as Louis Sullivan and Martin Roche, had tried to persuade the Sanitary District to improve the aesthetic quality of the bascules it was building for the city. The league particularly wanted a "monumental" treatment for the prominently sited State Street Bridge. The Sanitary District was initially receptive to the league's design suggestions, but it failed to act on them. In 1903, the league abandoned its efforts, noting that it had failed "to have any influence in the design of the new bridges across the Chicago River." Its president, Franklin MacVeah, declared, "A Chicago bridge is a depressing sight . . . It is a marvel that suicides from these bridges are so infrequent." Although Scherzer's design for the State Street Bridge failed to meet the league's aesthetic standards, its arched treatment of the structure was the first attempt in Chicago to beautify a movable bridge. See Municipal Art League of Chicago, *Year Book, Twentieth Century, Year One* (n.p., 1901), 5-6; *Year Book, Twentieth Century, Year Three* (n.p., 1903), 13; *Year Book, Twentieth Century, Year Four* (n.p., 1904), 10.

[35] At the time, both contracting firms were extremely active in the field of bascule-bridge construction. Jackson and Corbett's prior contracts were with the Sanitary District for Scherzer rolling lifts at Loomis Avenue, Harrison Street, and Eighteenth Street. Roemheld and Gallery's bascule projects had all involved fixed-trunnion bridges for the Department of Public Works, at Ninety-Fifth Street, East Division Street, and West Division Street. The firm's success with the Department of Public Works no doubt owed something to the fact that partner Jules E. Roemheld was well versed in the agency's engineering practices, having served as municipal Chief Bridge Engineer from 1896 to 1898. See City of Chicago, Department of Public Works, Bureau of Engineering, Division of Bridges, "Bridge History and Data," Drawing Nos. 16188-16192, 1943, rev. 1950, in CDT Plan Archives; John William Leonard, *Who's Who in Engineering, 1922-1923* (New York: John W. Leonard Corporation, 1922), 1073.

[36] Scherzer, "Supplemental Bill," 3; Scherzer, "Bill for Injunction," 7.

specifications to allow public bidding on the company's rolling-lift design, and the city denying that any agreement had been struck at all. This difference in opinion would soon trigger another lawsuit involving the city's construction of the North Halsted Street Bridge over the North Branch Canal.[37] For the moment, however, the Department of Public Works was free to pursue its original intentions regarding the North Avenue Bridge. The altercation, however, did have two significant repercussions. First, it brought into the open Ericson's hostility to the Scherzer Company. As Ericson himself admitted to the press in August 1905, "There is a contention between the Scherzer company and myself as to the load which is to be placed on any foundations for any bridges which it may build in the future in the city."[38] Second, the dispute prompted an administrative reorganization of the Department of Public Works. In July 1905, the department's bridge division was removed from Ericson's bailiwick and transformed into a separate administrative entity under Pihlfeldt's supervision. Henceforth, Pihlfeldt was "more or less independent of the City Engineer [i.e., Ericson,]" who exercised "only a general supervision over the [bridge] work." This reorganization would be of little solace to the Scherzer Company, for Pihlfeldt would prove to be as fervent a believer in the city's fixed-trunnion design as Ericson himself.[39]

The construction of the North Avenue bascule finally began in early 1906. As the substructure neared completion in December of that year, work commenced on the superstructure. The new bridge opened to traffic in October 1907.[40] Ericson and his colleagues in the city's bridge division had developed their fixed-trunnion bascule design to keep the Chicago River navigable for the city's commercial and industrial interests. During the first decades of the twentieth century, however, Chicago shipping patterns significantly changed, as the largest carriers increasingly bypassed the Chicago River's entrance on Lake Michigan near the downtown district in order to serve new manufacturing plants located near a deeper harbor at the mouth of the Calumet River in south Chicago. By the mid-1920s, Chicago River shipping tonnage had fallen off to such an extent that the Department of Public Works even suggested the adoption of "a fixed bridge policy" that "could be established beginning 1925, by converting or replacing the 41 existing [movable] bridges, starting in the outlying districts and gradually

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[37] The confusion over the North Avenue Bridge "agreement" is aired in the second lawsuit; see *Albert H. Scherzer v. City of Chicago et. al*, 1907, Circuit Court of Cook County, Case File No. 277091, in Clerk of the Circuit Court of Cook County, Illinois, Archives, Daley Center, Chicago, IL

[38] "Finds Flaws in Bridges, Ericson Criticizes Drainage Board Structures," *Chicago Tribune*, 15 August 1905, pt.1, 8.

[39] On the reorganization, see *DPW Annual Report, 1905*, 149; William L. O'Connel and Thomas G. Pihlfeldt, "Joint and Several Answer of the Defendants," 11 February 1907, in *Scherzer v. City of Chicago*, Case File No. 277,091, *DPW Annual Report, 1907*, 24. For Pihlfeldt's advocacy of the fixed-trunnion design, especially vis-a-vis the Scherzer Company, see Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, "North Halsted Street Bridge," HAER No. IL-160.

[40] *DPW Annual Report, 1906*, 284; *DPW Annual Report, 1907*, 9.

approaching the river mouth within ten years."[41] If such a policy were to be implemented, the city engineers projected an annual savings of almost $3 million, as movable bridges were much more expensive than fixed bridges to maintain and rebuild. At least partly because of opposition by the Army Corps of Engineers, which held to the belief that the Chicago River should be maintained as a navigable waterway, the city's movable bridges remained in operation.

Chicago's movable bridges proved to be a national asset during World War II, when commercial shipping on the Chicago River markedly increased. But the upsurge in traffic was a wartime anomaly rather than a revitalization. In the post-war period, shipping once again declined, and bridge openings increasingly served the needs of pleasure craft. In 1971, the city administration under Mayor Richard B. Daley once again called for closing many of the river spans, especially on the northern parts of the waterway. As the mayor's office reported, "The bridges are seldom lifted and permanent closing would mean a considerable saving on upkeep of the costly lift machinery . . . . Practically all the river traffic, including barges and tugs, have clearance to pass under the bridges without elevating them."[42] The Army Corps of Engineers eventually agreed, and by the 1990s, all of the North Branch and North Branch Canal bascules, including the North Avenue Bridge, were functioning as fixed highway spans.

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[41] City of Chicago, Department of Public Works, Bureau of Engineering, Division of Bridges, "Preliminary Report on Movable Bridges vs. Fixed Bridges," 16 April 1923, 1-2, in Government Documents Division, Harold Washington Municipal Library. The shift in shipping patterns can be traced in the comparative tonnage statistics for the Chicago River and Calumet Harbor that were presented each year by the Department of Public Works in its annual reports.

[42] "Plan to End Operation of 6 Lift Bridges," *Chicago Sun-Times*, 16 November 1971.

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